

Innovation and market orientation in smallholder pig production: the roles for access to veterinary services and use of purchased feeds

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Abstract

Purpose – This study aims to assess the relationship between market orientation and innovation while accounting for the use of purchased feeds and access to veterinary services.

Design/methodology/approach – This study used primary data collected from a cross-section of smallholder pig farmers in northern Uganda. Data were collected using pre-tested structured questionnaires. Collected data were analyzed in SPSS using descriptive statistics, exploratory factor analysis and hierarchical regression.

Findings – Results show that having improved breeds and providing housing to pigs improve system-focused innovation but reduce customer-focused innovation. The use of purchased feeds was associated with higher levels of both dimensions of innovation, while access to veterinary services was only associated with higher levels of system-focused innovation. Customer orientation is positive for both dimensions of innovation, while competitor orientation is positive for system-focused innovation, but negative for customer-focused innovation. Lastly, interfunctional innovation was only associated with higher levels of customer-focused innovation. Access to veterinary services and the use of purchased feeds influence the magnitude of the effect of market orientation on innovation.

Research limitations/implications – The findings of this paper suggest that improving smallholder pig farmers' market orientation could lead to a higher level of farm innovation. Similarly, improving access to veterinary services and better feeds could be linked to higher levels of market orientation, as well as farm-level innovation.

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Originality/value – This paper is original and contributes to the understanding of the relationship between market orientation and farm-level innovation in the context of pig production in a developing country.

Keywords Pig production, Smallholder innovation, Customer orientation, Competitor orientation

Paper type Research paper

1. Introduction

Recently, there has been an increasing number of Ugandan smallholder farmers taking pig production as a way of increasing their household incomes (Tatwangire, 2014; Twine and Njehu, 2020). Consequently, there has been a rise in the pig population in the country. The recent livestock census conducted by the Uganda Bureau of Statistics (UBOS) showed that the country has over 7.1 million pigs (UBOS, 2022, 2024), an increase of over 123% since the 2008 census (FAO, 2022). With an average of three pigs per herd, the number of pig-rearing households also doubled from 1.1 in 2008 to 2.2 in 2021 (UBOS, 2024). Unlike other domestic livestock species that are reared for multi-purpose roles including prestige in some parts of the country, pigs are usually reared solely for income generation (Babigumira *et al.*, 2019). This is attributed to the benefits associated with pig production including high market demand (Roesel *et al.*, 2019), high growth and fertility rates (Tatwangire, 2014; Ouma *et al.*, 2015) and low land requirements, which make pig production attractive to both urban and rural farmers (Tatwangire, 2014; Twine and Njehu, 2020).

However, challenges related to feeding, high incidences of diseases and parasites, and uncompetitive markets limit most farmers from realizing the benefits from pig production. Most feeds and feed ingredients available are expensive and usually of poor quality. According to Ouma *et al.* (2015), feeding accounts for between 60–80% of the total cost of production in most smallholder pig production systems. This high cost of feeds is largely due to the seasonality of most feed resources (Tatwangire, 2014; Atherstone *et al.*, 2019) and competition for most feed resources between livestock and human uses (Tatwangire, 2014; Ouma *et al.*, 2015). Similarly, Ouma *et al.* (2017) observed that the Ugandan feeds and feed ingredients markets are characterized by poor quality feeds largely due to intentional or unintentional adulteration. Smallholder pig production systems in Uganda are also characterized by the incidence of several parasites and diseases which limit the potential of pig production (Oba *et al.*, 2020; Dione *et al.*, 2014; Okello *et al.*, 2020, 2022; Twine and Njehu, 2020; Tatwangire, 2014). Incidence of African Swine Fever (ASF), an endemic disease (Atuhaire *et al.*, 2013) can result in 100% economic losses (Chenais *et al.*, 2015; Penrith, 2020; Tatwangire, 2014; Aliro *et al.*, 2023). Without factoring in the impact of African Swine Fever, these pig health challenges are responsible for over 23% of mortality and over 30% of morbidity (Tatwangire, 2014). These two main challenges are partly responsible for the regional variations in pig numbers across the country. Northern Uganda, for instance, has only about 14.7% of the total pig population in country, and, 14.9% of the total pig-rearing households in the country, despite its potential for poverty eradication (Arvidsson *et al.*, 2022a, b).

Faced with these challenges, farmers look for ways of overcoming them so as to earn more profits from pig production. These involve changes in routines. For instance, the use of multiple sources of feeds including local feed resources is becoming more common (Okello *et al.*, 2021; Katongole *et al.*, 2012; Carter *et al.*, 2017; Lumu *et al.*, 2013). With respect to pig health management, farmers also use options available to them irrespective of whether they are proven or not. For instance, a number of farmers have reportedly used local herbs, old engine oil and tobacco extracts to manage several pig health issues in their farms (Dione *et al.*, 2014; Okello *et al.*, 2022), with some limited success in some cases.

The options taken by farmers in addressing these challenges associated with pig feeding and pig health management usually depend on their level of market orientation (Mekuriaw and Asmare, 2014). Whereas almost all pig farmers go into pig production to generate income, their market orientation – how they view the market – with respect to their pig production usually dictates how far they undertake innovations to help solve key challenges

on the farm ([Arvidsson et al., 2022a, 2023](#)). These innovations usually constitute changes in routines relating to the challenges being faced ([Micheels and Nolan, 2016](#)). [Yaseen et al. \(2018\)](#) observed that market orientation helps farmers to overcome barriers and would improve their performance. Thus, an understanding of the relationship between market orientation, innovation, as well as feeding and pig health management practices are critical in proposing ways of improving the performance of smallholder pig production. By focusing on market signals, smallholder farmers are able to innovatively look for ways of solving challenges associated with their operations ([Devaux et al., 2018](#)). This study was conducted in view of understanding how smallholder pig farmers' market orientation drives innovation aimed at improving the overall functionality of the smallholder pig farm. Whereas there have been studies on market orientation and innovation (e.g. [Ho et al., 2018](#); [Yaseen et al., 2018](#)), to the best of our knowledge no such study as yet been conducted in smallholder pig production.

2. Literature review

This study is anchored on two specific research questions: (1) how does a smallholder pig farming household's level of market orientation influence its level of innovation and (2) is this influence different for those smallholder pig farmers who have access to veterinary services and use purchased feed [1] as opposed to those who do not. In smallholder pig production, farmers usually make production and marketing decisions with the hope of maximizing the outcomes associated with their actions. Consequently, farmers will choose the best course of action for their business given the circumstances at play. Depending on the production goals, differences in decisions and associated outcomes in smallholder agriculture may depend on their level of market orientation ([Mekuriaw and Asmare, 2014](#)). Market orientation refers to how a business entity becomes aware of existing marketing stimuli and the action taken to respond to the market stimuli. It refers to options taken by a farm to identify and prioritize consumer needs and respond with products that can meet such needs ([Ho et al., 2018](#)). The awareness of market stimuli is achieved through the generation of market intelligence, which largely depends on the information capability of the farmer ([Magesa et al., 2022](#); [Mugonya et al., 2021](#)). In practice, farmers receive such information from various sources. Farmer who make use of such information in improving their marketing outcomes are referred to as market-oriented ([Chilundo et al., 2020](#); [Twine and Njehu, 2020](#); [To-The and Nguyen-Anh, 2021](#)).

The concept of market orientation has its origins in the works of [Narver and Slater \(1990\)](#), [Kohli and Jaworski \(1990\)](#) and [Jaworski and Kohli \(1993\)](#). According to [Kohli and Jaworski \(1990\)](#), market orientation involves the firm-wide creation and utilization of market intelligence on the needs of both current and potential customers. [Narver and Slater \(1990\)](#) viewed market orientation as how a firm views its customers, competitors and internal coordination with the aim of achieving market orientation, which is sometimes confused with market participation. However, the two concepts are quite different in that market orientation is interested in how a given farm views the market ([Ho et al., 2018](#)). On the other hand, market participation refers to whether or not a farmer participates in the market ([Bolarinwa et al., 2021](#); [Otekunrin et al., 2019](#)). Consequently, in smallholder pig production, it is possible that all the farmers are already "market participants" but with different levels of market orientation, attributed to their motivations to start pig production. Market-oriented farmers will adopt practices that allow them to deliver superior value to consumers, have a competitive advantage and generate profits sustainably. For instance, such farmers tend to be pro-active in their production decisions, adopting strategies that improve their market outcomes ([Chilundo et al., 2020](#)). These strategies would be manifested in the farmers managerial experience. According to [Tindiwensi et al. \(2020\)](#), there is a strong relationship between farm management skills and the farmer's market orientation.

The concept of market orientation is not very common to primary agriculture and specifically in developing countries. However, findings from the studies so far conducted in the field of agriculture on market orientation (Micheels and Gow, 2008, 2011; Ho *et al.*, 2018) indicate that market orientation is also important to primary agricultural production. This study assessed market orientation in the context of smallholder pig production by adopting the market orientation conceptualization (Narver and Slater, 1990), that has been applied before in agribusiness (Micheels and Gow, 2008, 2011) and primary agricultural production (Ho *et al.*, 2018). According to Narver and Slater (1990), market orientation consists of different concepts including customer orientation, competitor orientation and interfunctional coordination. A strong market orientation is usually associated with better business outcomes. However, each of the concepts of market orientation may have a different impact on market orientation (Micheels and Gow, 2011; Ho *et al.*, 2018; Na *et al.*, 2019). Generally, market-oriented farms are expected to undertake innovative activities that will translate into better business outcomes. Such innovations usually focus on increasing value, improving operational efficiency, learning experiences and strategies to reduce cost (Micheels and Gow, 2008). In the agri-food sector, such innovations can lead to changes to the product (product innovation), how its marketed (market innovation), how it is produced and handled (process innovation) or organization innovation (Caiazza *et al.*, 2014; Aksoy, 2017). Measurement of innovation thus focuses on the four concepts of product, market, process and organization innovations (Iza and Dentoni, 2020). In practice, the four concepts can be collapsed into one or two concepts to measure the level of innovation in a given firm (Aggrey *et al.*, 2021; Ho *et al.*, 2018; Caiazza *et al.*, 2014). This study adopts a two-concept innovation model involving customer-focused and system-focused innovation. Innovation focusing on improving value involves changes around the product and how its marketed. This type of innovation may also be referred to as customer-focused innovation (Kamuri, 2021; Iza and Dentoni, 2020; Caiazza *et al.*, 2014). On the other hand, innovation focusing on improving operational efficiency usually involves changes around the process (process innovation) and organization (organization innovation). This type of innovation is referred to as system-focused innovation (Ajer *et al.*, 2023; Caiazza *et al.*, 2014; Kamuri, 2021).

In the Ugandan context, such innovations would be expected to improve both production and marketing outcomes. Specifically, customer-focused innovation is expected to largely relate to changes in how the smallholder farmer markets these products (Atherstone *et al.*, 2019). Similarly, system-focused innovation is expected to largely relate to changes in pig management strategies aimed at improving efficiency (Ouma *et al.*, 2018; Katongole *et al.*, 2012). In both cases, the focus of the smallholder farmer would be to earn more income from pig production amidst production and marketing challenges (Arvidsson *et al.*, 2022a, b). With this in mind, the current study was interested in understanding how each of the different concepts of market orientation influences the level of customer-focused innovation and system-focused innovation in smallholder pig production. Consequently, the following hypotheses were tested:

H1a. Customer orientation has a positive influence on customer-focused innovation

H1b. Customer orientation has a positive influence on system-focused innovation

H2a. Competitor orientation has a positive influence on customer-focused innovation

H2b. Competitor orientation has a positive influence on system-focused innovation

H3a. Interfunctional coordination has a positive influence on customer-focused innovation

H3b. Interfunctional coordination has a positive influence on system-focused innovation

Pig feeding decisions and access to veterinary services are expected to affect levels of market orientation and both customer-focused and system-focused innovations. However, in smallholder production systems, not all farmers adopt better feeding practices or have access to veterinary services. In practice, farmers usually only those practices that they think would give them the best utility. In the Ugandan context, there is evidence of differential access to veterinary services (Aliro *et al.*, 2022; Okello *et al.*, 2020), as well as, the use of processed feeds (Okello *et al.*, 2021). This raises the question of whether or not there are differences in the level of innovation and market orientation between those who have adopted some of the best practices and those who have not. Consequently, the influence of market orientation on farm-level innovation would be different for the different groups of farmers. With respect to the use of purchased feeds and access to veterinary services, we tested the following hypotheses:

- H4a.* The influence of market orientation on farm-level innovation of pig farmers who use purchased feeds is positive and significant
- H4b.* The influence of market orientation on farm-level innovation of pig farmers who have access to veterinary services is positive and significant
- H4c.* The influence of market orientation on farm-level innovation of pig farmers who do not use purchased feeds is negative and significant
- H4d.* The influence of market orientation on farm-level innovation of pig farmers who do not have access to veterinary services is negative and significant

3. Methodology

3.1 Study area

This study was conducted in the districts of Lira, Kole, Gulu, Amuru, Omoro and Nwoya districts in northern Uganda. Lira district is located on geographical coordinates 02°20' north and 33°06' east. Kole district is located on geographical coordinates 02°24' north and 32°48' east. Gulu district is located on geographical coordinates 02°45' north and 32°00' east. Amuru district is located on geographical coordinates 02°50' north and 33°05' east. Omoro district is located in geographical coordinates 02°35' north and 32°22' east. Nwoya district is located in geographical coordinates 02°38' north and 32°00' east. The districts were selected purposively following high pig numbers and a high number of households involved in pig rearing. These districts have more than a 25% of all the pigs in northern Uganda (UBOS, 2022). In all the districts, the main economic activities involve both crop and livestock farming, with pig production constituting an important enterprise.

3.2 Design, population and sample

This study used primary data collected following a cross-sectional survey research design. The study population consisted of smallholder pig-producing households who have been in pig production continuously for at least two years. This restriction to a minimum of two years was necessary given in smallholder pig production, farmers tend to pause production due to several factors including the outbreak of diseases. Consequently, those who had just returned to pig production would have found it hard to answer some of the questions especially those that relate to market orientation and innovation. The study used the services of the district production offices in enforcing the inclusion criteria. Prior to data collection, informed consent was sought for from all participants selected for the study. A total of 367 smallholder pig-producing households who met the inclusion criteria, consented to be interviewed and provided complete responses during interviews where thus included in the study. The sample

for this study was determined using the [Krejcie and Morgan \(1970\)](#) table of sample size determination. Estimates using the Uganda Bureau of Statistics ([UBOS, 2022](#)) information show that, collectively, the study areas have about 25,000 smallholder pig-producing households. Thus, a sample size of 377 was ideal following [Krejcie and Morgan \(1970\)](#). However, after the successful completion of data collection, information from 10 questionnaires could not be used and were thus dropped from the analysis, reducing the final sample to 367. This drop in sample size did not in any way affect the validity of the study given that it was within the margin of error factored in the sample size determination.

3.3 *Measurements and data collection*

Primary cross-sectional data was collected using hard-copy structured interviewer-administered questionnaires. The questionnaire contained questions on the farmers' demographic characteristics, farm characteristics, market orientation and innovation. The questions on farmer's demography and farm characteristics were easy to measure since they were mostly direct questions such as marital status, sex, farming experience, breed on the farm and access to services. However, measuring market orientation and innovation in a smallholder setting is usually not direct. The measurement of market orientation and innovation in this study adopted and modified the scales previously used in prior studies. Specifically, the measurement of market orientation followed the approach by [Micheels and Gow \(2008\)](#) and [Ho et al. \(2018\)](#), which was based on the [Narver and Slater \(1990\)](#) market orientation concept. Similarly, innovation was measured based on scales previously used by ([Gellynck et al., 2015](#); [Aksoy, 2017](#); [Ho et al., 2018](#); [Micheels and Gow, 2008](#)). Both market orientation and innovation scales included a set of statements that were answered on a Likert scale. This study adopted a five-point Likert scale ranging "strongly disagree" (1) to "strongly agree" (5) in the case of market orientation statements, and "not at all" (1), to "very well" (5) in the case of innovation statements. Data were collected by a team of four enumerators, under the supervision of the first author. All the enumerators had a background in agribusiness. Prior to data collection, informed consent was obtained from selected farmers. In the event that a farmer refused to participate in the study, that farmer was replaced with another who has consented. This was done so as to maintain the sample size.

3.4 *Statistical analyses*

Following field data collection, all questionnaires were checked for completeness and accuracy of the information captured. This checking was done during field data collection, by the field supervisor (first author) later in the day, before proceeding with data collection the following day. Only questionnaires that had complete information were entered into a spreadsheet for further processing. The spread sheet used for data entry was SPSS v.25. After data entry, data cleaning was then performed by running a preliminary descriptive analysis to identify any potential missing entries. Such were corrected by cross-checking with the hard-copy questionnaires. This was possible given that all questionnaires were assigned questionnaire numbers that corresponded to the raw numbers in the spreadsheet. The cleaned dataset was then subjected to analysis.

Data analysis involved exploratory factor analysis (EFA), descriptive statistics, correlation and regression analyses. Specifically, EFA was used to assess the reliability and validity of the measurement items relating to market orientation and innovation. It also allowed for the development of composite variables. Descriptive statistics involved means and standard deviations, while the Pearson pairwise correlation analysis was performed to assess the significance of correlation among variables.

Finally, a hierarchical linear regression analysis was performed to assess the influence of market orientation on innovation. In this study, given that the dependent variable, innovation was measured following two constructs (customer-focused innovation and system-focused innovation), a separate hierarchical regression was estimated for each. The control variables in

the hierarchical regression were organized at two levels, the first being farmer characteristics (marital status, sex, farming experience and location of the farmer). Entered at the second level were variables relating to farm characteristics that included a dummy for pig breed on farm (improved), a dummy for whether pigs are housed or not, a dummy for the use of purchased feeds and a dummy for access to veterinary services. The three constructs of market orientation were included in the third level of the hierarchical linear regression. In order to assess the differential influence of market orientation on innovation with respect to the use of purchased feeds and access to veterinary services, we estimated subsample linear regressions for those who had access to veterinary services, as well as for those who were using purchased feeds. This implies four separate regressions were estimated for each measure of innovation as the dependent variable and the constructs of market orientation as independent variables; These are (1) those who do not use purchased feeds (M1 and M5), (2) those who use purchased feeds (M2 and M6), (3) those who have no access to veterinary services (M3 and M7) and (4) those who have access to veterinary services (M4 and M8).

3.4.1 Tests of factorability, validity and reliability. Based on the scales used for measuring market orientation and innovation, this study used factor analysis to test for reliability and validity of the constructs. According to [Janssens et al. \(2008\)](#), EFA is appropriate if there are at least 10 times as many participants for every variable. Both market orientation and innovation constructs met this requirement. In this study, we conducted EFA using principal component analysis with varimax rotation [2] to determine the appropriate factor solution for both market orientation and innovation. During the factor analysis, the Kaiser–Meyer–Olkin (KMO) test and Bartlett’s test of Sphericity were also used to assess sample adequacy and suitability of the data measuring market orientation and innovation in smallholder pig farming. For both market orientation and innovation, the KMO test and Bartlett’s test confirmed sample adequacy for factor analysis. Once the appropriate solution was arrived at, internal consistency of each of the EFA-derived factors was conducted. This was done to justify developing a composite variable for each factor. Internal consistency was assessed by estimating the Cronbach’s alpha for each of the EFA-derived factors ([Tables 1 and 2](#)). Only factors that passed the reliability test were used to generate a single score, that was later taken to the next stage of data analysis.

During the EFA, items that had lower factor loadings (below 0.5) or those with strong cross-loadings were dropped ([Field, 2009](#); [Janssens et al., 2008](#)). The final EFA solution using principal component analysis with varimax rotation explained 64% of the total variation in the sample in the case of market orientation and 61% of the total variance in the sample in the case of farm innovation. The EFA results for market orientation resulted in a three-factor solution. These are customer orientation, competitor orientation and interfunctional coordination ([Table 1](#)).

In the case of innovation, EFA yielded a two-factor solution. These are customer-focused innovation and system-focused innovation ([Table 2](#)). All the items in the final solution had factor loadings above 0.551 ([Tables 1 and 2](#)). The Cronbach’s alpha test for the components of both market orientation and innovation were above 0.7. According to [Nunnally \(1994\)](#), a Cronbach’s alpha value above 0.7 indicates good internal reliability.

4. Results

4.1 Descriptive statistics and correlation results

The study participants were 52% females, 48% males and over 78% of the farmers were married ([Table 3](#)). On average, the pig farmers in this study had been farming for 17 years, and about 31% of the farmers were located in urban areas. Local pig breeds were dominant, but 49% of the farmers kept improved breeds. The improved breeds were either crosses or pure exotic breeds [3]. Only 31% of the farmers housed their pigs, and 64% used processed feeds as the main source of feed for their pigs. Only 38% of the pig farmers had accessed veterinary services. The mean score of customer-focused innovation was 2.26 of 5, which is equivalent to 45.2%. On the other hand, the mean score of system-focused innovation was 2.51 of 5,

Table 1. Factor analysis for market orientation

Scale items	F1	F2	F3
We evaluate the strengths and weaknesses of key pig farmers' that we compete with	0.844		
We identify the areas where our key competitors/pig farmers have succeeded or failed	0.826		
In my pig farm, we regularly discuss the strength and weakness of other pig farmers	0.800		
In my pig farm, we share information concerning other pig farmers activities	0.739		
I anticipate what customers might need and suggest new ways of addressing it		0.760	
I think about the benefits that customers receive from my pig/pork products		0.747	
I try to recognize the needs of my customers months or even years before the majority of market may notice them		0.741	
I try to innovate the current pig business to meet customer needs even if I recognize a possibility of risk		0.736	
In my pig farm, we target customers where we have an opportunity to out-compete our competitors/other pig farmers		0.551	
We regularly visit our current customers			0.863
We regularly visit our prospective customers			0.860
I am in close contact with lead customers in order to address their needs			0.674
<i>Eigenvalue</i>	4.289	2.007	1.455
<i>Percentage of variance</i>	35.744	16.728	12.125
<i>Cumulative percentage of variance</i>	35.744	52.472	64.597
<i>Cronbach's alpha</i>	0.779	0.850	0.777
Note(s): Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO = 0.796)			
Bartlett's test of Sphericity (Chi-square = 1758.708, <i>p</i> -value = 0.000)			
F1= Customer orientation; F2 = Competitor orientation, F3= Inter functional coordination			
Source(s): Authors' own work			

equivalent of 50.2%. This implies that smallholder pig farmers in this study were averagely innovative.

With respect to market orientation, the mean score of customer orientation, competitor orientation and interfunctional coordination were 3.24, 2.8 and 3.07 of 5, respectively. The average level of market orientation of pig farmers in this study was thus at 3.04. If expressed as a percentage, this would be 61%. Generally, all the correlation coefficients were less than 0.5 in absolute terms. Correlation results showed that systems-focused innovation had positive significant correlations with all variables except the control variables of farming experience, sex and marital status. On the other hand, customer-focused innovation has a significant correlation with farming experience, use of purchased feeds, customer orientation and interfunctional coordination. The use of purchased feeds is significantly correlated with customer orientation, competitor orientation and interfunctional coordination, while access to veterinary services is significantly correlated with both competitor orientation and interfunctional coordination (Table 3).

4.2 Regressions results

The hierarchical regression results are presented in Table 4 for customer-focused innovation and Table 5 for system-focused innovation. These results reveal that the level of customer-focused innovation in smallholder pig production was significantly associated with having improved pig breed (β : -0.082 ; $p < 0.1$), housing pigs (β : -0.090 ; $p < 0.01$), using processed feeds (β : 0.482 ; $p < 0.01$), competitor orientation (β : -0.138 ; $p < 0.01$), customer orientation (β : 0.363 ; $p < 0.01$) and interfunctional coordination (β : 0.174 ; $p < 0.01$). These findings imply that hypotheses H1a which states that *Customer orientation has a positive influence on customer-focused innovation* and H3a which states that *Inter functional coordination has a*

Table 2. Factor analysis for smallholder pig farm innovation

Scale item	F1	F2
I have standard procedure when it comes buying inputs (e.g. feeds, drugs, etc.) for my pig farm	0.882	
There is a standard procedure when it comes to identifying buyers of pig or pig products in our pig farm	0.866	
We continually provide different products to the market as	0.828	
We usually change our pig products (e.g. live pig, pork, piglets etc.) with respect to changing conditions	0.805	
Our pig/pig produces are usually sold at market place (e.g. home, market etc.) that is most competitive	0.717	
Our pig production processes are changed according to changing conditions	0.638	
In marketing our pigs or pig products we create awareness of the availability of our products using innovative promotion approaches	0.629	
The management structure in my pig farm is the most innovative in all pig farms I know	0.590	
We adopt new techniques in our pig production process		0.833
I implement new techniques in production of my products		0.818
We create new processes in our pig production in order to improve efficiency		0.633
I develop new ideas of improving my pig products		0.623
<i>Eigenvalue</i>	5.182	2.101
<i>Percentage of variance</i>	43.184	17.511
<i>Cumulative percentage of variance</i>	43.184	60.695
<i>Cronbach's alpha</i>	0.896	0.747

Note(s): Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO = 0.837)

Bartlett's test of Sphericity (Chi-square = 2389.262, p -value = 0.000)

F1 = Customer-focused innovation; F2 = Systems focused innovation

Source(s): Authors' own work

positive influence on customer-focused innovation are supported by the findings. On the other hand, hypothesis H2a which states that *Competitor orientation has a positive influence on customer-focused innovation* cannot be supported since the influence of competitor orientation on customer-focused innovation is negative.

The level of system-focused innovations in smallholder pig production were significantly influenced by improved pig breed on farm (β : 0.090; $p < 0.1$), housing of pigs (β : 0.130; $p < 0.05$), use of processed feeds (β : 0.098; $p < 0.05$), access to veterinary services (β : 0.133; $p < 0.05$), competitor orientation (β : 0.205; $p < 0.01$) and customer orientation (β : 0.308; $p < 0.01$) (Table 5). Interfunctional coordination did not have any significant influence on system-focused innovations. These findings imply that hypothesis H1b which states that *Customer orientation has a positive influence on system-focused innovation*, and H2b which states that *Competitor orientation has a positive influence on system-focused innovation*, are supported, while, H3b which states that *Inter functional coordination has a positive influence on system-focused innovation* cannot be supported.

In both models, regression results show that for both system-focused and customer-focused innovations, the farmer characteristics were not significant. This non-significance of the farmer characteristics on innovations suggests that the influence of market orientation on innovation is least affected by confounding factors related to the farmer characteristics investigated. The influence of market orientation is thus expected not to be dependent on the farmer characteristics. However, the relationship between market orientation and innovations seems to be sensitive to factors related to pig characteristics, including the use of purchased feeds and access to veterinary services.

Results in Table 6 show that the influence of market orientation on innovation varies by the status of the use of purchased feeds and access to veterinary services. With respect to the use of purchase feeds, the findings indicate that competitor orientation had a negative association

Table 3. Means, standard deviations and correlation among variables

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
Customer focused innovation	2.26	0.98	1											
System focused innovation	2.51	0.93	0.303***	1										
Married	0.78	0.41	0.04	−0.004	1									
Sex	0.52	0.50	0.035	−0.005	−0.031	1								
Farming experience	17.7	0.92	0.100*	0.037	0.183***	−0.044	1							
Farm location	0.31	0.46	−0.001	0.270***	−0.034	0.038	−0.166***	1						
Breed	0.49	0.50	−0.037	0.320***	0.043	−0.029	−0.03	0.337***	1					
Housed	0.31	0.46	−0.027	0.211***	−0.048	0.002	−0.081	0.054	0.314***	1				
Use of processed feeds	0.64	0.48	0.463**	0.091*	−0.014	0.127**	0.084	−0.001	0.059	0.147***	1			
Access to veterinary services	0.38	0.49	−0.025	0.307***	0.140***	−0.150***	0.099*	0.258***	0.223***	−0.058	−0.229***	1		
Competitor orientation	3.24	0.92	−0.019	0.421***	0.127**	0.013	0.08	0.262***	0.314***	0.049	−0.089*	0.433***	1	
Customer orientation	2.80	0.71	0.357***	0.477***	0.012	−0.06	0.021	0.280***	0.226***	0.114**	0.075	0.235***	0.337***	1
Inter functional coordination	3.07	1.00	0.095*	0.234***	0.159***	−0.044	0.02	0.109**	0.116**	−0.053	−0.236***	0.371**	0.403***	0.251***

Note(s): $n = 367$; Married = dummy variable (0: not married, 1: married); Gender = Dummy (0: male, 1: female); Farm location = dummy (0: rural, 1 = urban); Breed = dummy (0: local, 1: Improved (exotics and crosses)); Housed = Dummy (0: no housing to pigs, 1: pigs housed); Use of processed feeds = Dummy (0: Main feed source is from home, 1: main feed source is through purchase); Access to veterinary services = Dummy (0: no access, 1 = Access); in case of dummies, means represent proportions and are converted to percentages by multiplying by 100 in the interpretation; *, ** and *** implies significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively

Source(s): Authors' own work

Table 4. Determinants of customer-focused innovation in smallholder pig production in Northern Uganda

Variable	Beta (t-statistics) Model 1	Model 2	Model 3
Intercept	1.892 (10.113) ***	1.513 (8.575) ***	0.199 (0.798)
<i>Farmer characteristics</i>			
Married	0.024 (0.449)	0.028 (0.581)	0.022 (0.498)
Sex	0.039 (0.748)	−0.015 (−0.324)	0.009 (0.207)
Farming experience (log years)	0.100 (1.851) *	0.038 (0.785)	0.036 (0.815)
Location (1 = Urban)	0.015 (0.288)	0.012 (0.234)	−0.050 (−1.054)
<i>Farm characteristics</i>			
Breed (1 = Improved)		−0.068 (−1.292)	−0.082 (−1.690) *
Housed (1 = Yes)		−0.070 (−1.401)	−0.090 (−1.994) **
Use of processed feeds		0.496 (10.168) ***	0.482 (10.668) ***
Access to veterinary services		0.086 (1.672) *	0.016 (0.318)
<i>Market Orientation</i>			
Competitor orientation			−0.138 (−2.684) ***
Customer orientation			0.363 (7.744) ***
Inter functional coordination			0.174 (3.572) ***
<i>Model parameters</i>			
R ²	0.012	0.236	0.381
Adjusted R ²	0.001	0.219	0.362
F-value (sig)	1.124 (0.345)	13.814 (0.000)	19.904 (0.000)
R ² Change	–	0.224	0.146
F-change	–	26.192	27.853
Max VIF	1.064	1.305	1.522
Tolerance	0.940–0.997	0.767–0.961	0.657–0.948

Note(s): *, ** and *** implies significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively

Source(s): Authors' own work

with customer-focused innovation in all groups. On the contrary, competitor orientation had a negative association system-focused innovation for farmers using purchase feeds as well as those not using. Table 6 presents mixed findings with respective hypothesis H4. For instance, hypothesis H4a which states that the *influence of market orientation on farm-level innovation of pig farmers who use purchased feeds is positive and significant* was fully supported for customer orientation, but only supported partially supported for competitor orientation and interfunctional coordination. Similarly, hypothesis H4b, which states that *the influence of market orientation on farm-level innovation of pig farmers who have access to veterinary services is positive and significant* was also fully supported for customer orientation, but only supported partially for competitor orientation and interfunctional coordination. Further, the results show that hypotheses H4c which states that, *the influence of market orientation on farm-level innovation of pig farmers who do not use purchased feeds is negative and significant*, and H4d which states that *the influence of market orientation on farm-level innovation of pig farmers who do not have access to veterinary services is negative and significant* could only be partially supported in all cases. For instance, the influence of customer orientation was positive and significant for farmers who did not use purchase feeds or were not accessing veterinary services, while H4c and H4d expected that the influence would be negative.

A comparison of the subsample analysis results (Table 6) and pooled model results (Tables 4 and 5) shows consistency in the direction of significance for competitor orientation and customer orientation, but variations in significance for interfunctional coordination. Specifically, interfunctional coordination which was significant in the general model

Table 5. Determinants of system-focused innovation in smallholder pig production in Northern Uganda

Variable	Beta (t-statistics) Model 1	Model 2	Model 3
Intercept	2.135 (12.773) ***	1.758 (10.306) ***	0.155 (0.642)
<i>Farmer characteristics</i>			
Married	−0.010 (−0.204)	−0.044 (−0.917)	−0.059 (−1.337)
Sex	−0.012 (−0.236)	0.022 (0.456)	0.020 (0.469)
Farming experience (log years)	0.086 (1.650)	0.051 (1.033)	0.026 (0.582)
Location (1 = Urban)	0.284 (5.555) ***	0.143 (2.755) ***	0.055 (0.258)
<i>Farm characteristics</i>			
Breed (1 = Improved)		0.159 (2.988) ***	0.090 (1.821) *
Pigs are housed (1 = Yes)		0.155 (3.082) ***	0.130 (2.856) ***
Use of purchased feeds		0.114 (2.317) **	0.098 (2.146) **
Access to veterinary services		0.274 (5.253) ***	0.133 (2.589) **
<i>Market Orientation</i>			
Competitor orientation			0.205 (3.930) ***
Customer orientation			0.308 (6.506) ***
Inter functional coordination			0.049 (0.990)
<i>Model parameters</i>			
R ²	0.080	0.219	0.366
Adjusted R ²	0.070	0.201	0.347
F-value (sig)	7.866 (0.000)	12.866 (0.000)	18.667 (0.000)
R ² Change	–	0.139	0.148
F-change (sig)	–	15.925 (0.000)	27.551 (0.000)
Max VIF	1.064	1.305	1.522
Tolerance	0.940–0.997	0.767–0.961	0.657–0.948
Note(s): *, ** and *** implies significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively			
Source(s): Authors' own work			

(Table 4), is no longer significant on customer-focused innovation for those who do not use purchased feeds. It is, however, significant on customer-focused innovation for those who use purchased feeds in their pig productions.

5. Discussions

This study assessed the influence of market orientation on innovation in the context of smallholder pig farming in a developing country. Market orientation studies focusing on primary production such as the current study have largely been lacking in literature (Ho *et al.*, 2018). However, market orientation and innovation are important in enhancing the competitiveness and sustainability of such smallholder farms that dominate most developing countries (Mekuriaw and Asmare, 2014). This paper presents new findings on the relationship between market orientation and innovation in smallholder pig production. It identifies a number of factors that influence innovation in smallholder pig farming. Specifically, farmers who had improved pig breeds were associated with lower levels of customer-focused innovation, but higher levels of system-focused innovation. Similarly, pig housing was associated with lower levels of customer-focused innovation, but higher levels of system-focused innovation. Both the rearing of improved breeds and the provision of housing in pig production are related to best practices expected of better-performing farms.

The negative influence of having improved breeds or pig housing on customer-focused innovation is thus not surprising. In most smallholder systems, farmers decision to adopt improved practices is usually driven by market and non-market factors. The findings of this

Table 6. Group-level analysis for use of purchased feeds and access to veterinary services and customer-focused innovation

Market orientation	Beta (<i>t</i> -statistics) Customer-focused innovation				System-focused innovation			
	Use feed resources from home (M1)	Use purchased feeds or feed ingredients (M2)	No access to veterinary services (M3)	Access to veterinary services (M4)	Use feed resources from home (M5)	Use purchased feeds or feed ingredients (M6)	No access to veterinary services (M7)	Access to veterinary services (M8)
Intercept	0.67 (2.79) ***	0.98 (3.25) ***	1.23 (4.15) ***	0.68 (0.14)	−0.35 (−0.89)	0.49 (2.04) **	0.77 (3.10) ***	−0.53 (−1.20)
Competitor orientation	−0.23 (−2.25) **	−0.14 (−2.23) **	−0.22 (−3.37) ***	−0.03 (−0.367)	0.23 (2.51) **	0.29 (4.96) ***	0.20 (3.20) ***	0.31 (3.97) ***
Customer orientation	0.44 (4.97) ***	0.35 (5.55) ***	0.23 (3.56) ***	0.58 (7.70) ***	0.27 (3.31) ***	0.43 (7.36) ***	0.36 (5.78) ***	0.36 (4.83) ***
Interfunctional coordination	0.12 (1.18)	0.25 (4.09) ***	0.30 (4.59) ***	−0.19 (−2.55) **	0.18 (1.91) *	−0.05 (−0.94)	−0.06 (−1.20)	0.07 (0.97)
Number of Observations	132	235	228	139	132	235	228	139

Note(s): *, ** and *** imply significance at $p < 0.1$, $p < 0.05$ and $p < 0.01$, respectively; dependent variable for M1–M4 is customer-focused innovation; dependent variable for M5–M5 is system-focused innovation; for all eight cases, the independent variables are: competitor orientation, customer orientation and interfunctional coordination

Source(s): Authors' own work

study suggest that use of improved breeds as well as the provision of housing to pig could have been driven by non-market factors which include the promotion of these practices by extension agents. Whereas crosses and pure improved pig breeds have been shown to have high marketability, as opposed to local breeds (Coleman, 2018), they are also the breeds of choice promoted by most extension efforts. Even with most consumers becoming sensitive to what they eat as shown by increased preference for lean pork (Roesel *et al.*, 2019), most smallholder farmers are unable to undertake customer-focused innovation. This is because such farmers are unknowingly meeting the market requirements of consumers. However, these improved pig breeds are usually not as hardy as the local breeds (Tatwangire, 2014; Twine and Njehu, 2020) and would require farmers to be more innovative in their husbandry practices, if they are to get the best outcomes from their production. This is why the breed has a negative influence on customer-focused innovation but a positive influence on system-focused innovation.

In the smallholder pig production systems, most farmers do not provide housing to their pigs with the aim of improving the marketability of the products. Rather, housing is one of the husbandry practices that is linked to the safety of the pigs. This safety can be in terms of preventing theft of the pigs and/or effective disease control. For instance, most farmers usually confine their pigs either by housing them or tethering during periods of African Swine Fever outbreaks (Aliro *et al.*, 2022; Chenais *et al.*, 2017, 2019; Penrith *et al.*, 2021). As such, pig housing is mainly associated with improving the operations of farms rather than marketing outcomes.

Results from the current study also show that the use of purchased feeds was associated with high levels of both customer-focused and system-focused innovations. This was expected given that the profitability of pig production largely depends on better feeding at an affordable cost. In essence, feeding operations which are a daily activity in any pig farm, influence both farm operations and marketing outcomes. In order to remain profitable, pig farmers thus have to be innovative in feeding their pigs, while also focusing on the feed cost. While buying feeds, farmers usually prefer buying feed ingredients amidst challenges of scarcity and poor quality of feeds and feed ingredients (Ouma *et al.*, 2017). Using such feeds would require some level of innovation so as to obtain the best possible operational outcomes. Where it is not possible to avoid and/or reduce feed costs, such as when processed feeds are used, such farmers have to find the best ways of marketing their pigs so as to earn profits. On the other hand, farmers who rely on feeds from their farm residues and domestic waste do not incur any feeding costs and as such would be less innovative in solving the challenges associated with feeding their pigs.

The provision of veterinary services to smallholder pig farmers is critical in improving the operational performance of such farms. This is so given the high incidences of pig diseases and parasites in smallholder pig production systems (Dione *et al.*, 2014; Okello *et al.*, 2022; Tatwangire, 2014; Twine and Njehu, 2020). Findings from the current study showed that access to veterinary services was associated with positive levels of system-focused innovation, but was not significant for customer-focused innovations. In essence, a farmer who had access to veterinary services were more innovative in their operations than those who did not. This finding suggests that veterinary access could be providing farmers with options and strategies to improve their operations on farms. Most times, extension services do not focus on improving marketing operations. In livestock production, investments in the control and prevention of diseases and parasites will help avoid the total loss that would have occurred if nothing had been done. In essence, such interventions in pig health management such as accessing veterinary services may make the products appealing to the market, implying innovations related to marketing are unnecessary (Ouma *et al.*, 2018).

Market orientation has been shown to be beneficial in enhancing the competitiveness of farms (Micheels and Gow, 2008, 2015; Mirzaei *et al.*, 2016; Yaseen *et al.*, 2018). According to Okello and Luttah (2022), market orientation improved dairy farmer resilience, leading to better performance. In this study, competitor orientation had a negative influence on customer-focused innovation, but a positive influence on system-focused innovation. On the other hand, customer orientation had a positive influence on both customer-focused and system-focused

innovations. Interfunctional coordination has a positive influence on customer-focused innovations, but no influence on system-focused innovations. A study by [Ho et al. \(2018\)](#) reported that only customer orientation and inter functional coordination had a significant influence on innovation in the study conducted in Vietnam on the beef cattle value chain. In the same study, competitor orientation was reported as not significant, although its coefficient had a negative sign. Another study by [Kamarulzaman et al. \(2021\)](#) presented positive correlations between all dimensions of market orientation and all dimensions of innovation for agro-food manufacturers in Malaysia.

In smallholder pig production, competitor orientation is important in harnessing changes around the farm operations, and as such, the positive influence of competitor orientation on system-focused innovations is justifiable. However, in smallholder pig farming, farmers usually collaborate in the production of products ([Roesel et al., 2019](#); [Atherstone et al., 2019](#); [Ouma et al., 2017](#)), but not during the marketing of livestock products. Consequently, such collaboration is expected to translate into system-focused innovations as opposed to customer-focused innovations. In a typical smallholder pig farmer system, farmers usually share production resources and information including breeding boars ([Dione et al., 2014](#); [Aliro et al., 2022](#); [Aliro et al., 2023](#)). Thus, the negative influence of competitor orientation on customer-focused innovations suggests a lack of effort to outcome other pig farmers in the market. This is opposed to the expectation of competitor orientation that would require them to devise ways of out-competing their competitors.

With smallholder pig production becoming highly competitive in market specifications ([Roesel et al., 2019](#); [Atherstone et al., 2019](#); [Ouma et al., 2017](#)), a focus on the customer in all processes is critical in improving the performance of smallholder pig production. This explains why, in this study, customer orientation was positive for both dimensions of innovation. In essence, a competitive farmer has to adopt practices that would allow them to produce what the market wants. After production, the farmer has to find the best ways of presenting their products to the market so as to earn the best income. An increase in customer orientation is thus expected to harness the level of innovation in smallholder pig production leading to better performance. According to [Neneh \(2018\)](#), customer orientation has been shown to improve business performance. Customer orientation requires the smallholder holder pig farmer to understand what the consumers want and then innovate their business around the needs of the consumers ([Ajer et al., 2023](#)).

The findings from this study have also shown that interfunctional coordination is only important for customer-focused innovation pooled samples. However, from the subsample analysis results, the influence of interfunctional coordination was different for each subsample. Specifically, the influence of interfunctional coordination on customer-focused innovation was positive for farmers who used purchased feeds or had access no access to veterinary services. Additionally, the influence of interfunctional coordination on customer-focused innovation was negative for farmers who had access to veterinary services. This finding is similar to earlier studies ([Micheels and Gow, 2008](#); [Johnson et al., 2009](#); [Ho et al., 2018](#)). Interfunctional coordination relates to interactions with departments within the farm. In a typical smallholder pig farming household, interfunctional coordination is related to how the different household members coordinate in performing the different pig production tasks in a timely and proper manner. This plays a critical role in information sharing within the firm ([Mugonya et al., 2021](#)). Such information may be related to the changes in consumer preference which are vital for influencing customer-focused innovation. Results also showed that, interfunctional coordination was important for system-focused innovation in the case of farmers who do use purchased feeds. This finding underscores the importance of interfunctional coordination in transmitting relevant information within the firm. For the farmers in this study, interfunctional coordination was associated with higher levels of system-focused innovations, for farmers that were not using purchased feeds. Being aware of such information implies that interfunctional coordination would improve marketing outcomes, thus increasing the level of customer-focused innovation.

6. Conclusions and recommendation

This study presents empirical evidence on the relationship between market orientation and innovation in smallholder pig production. It shows that increasing customer orientation would positively drive the levels of both dimensions of innovations, while competitor orientation positively drives system-focused innovation, but negatively drives customer-focused innovations and interfunctional coordination positively drives customer-focused innovations. The magnitude of the impact is however influenced by other factors including the use of processed feeds and access to veterinary services. Harnessing these factors can practically lead to higher levels of innovations in smallholder pig production. Such innovations usually depict changes in routines associated with the challenges faced by the farmers.

The contributions of this study are twofold. First, the practical contribution is the provision of evidence on factors influencing innovations in smallholder pig production. Such innovations are necessary precursors of competitiveness and better performance of pig farms. Efforts to promote improved breeds, adopt pig housing, use processed feeds and provision of veterinary services improve the innovativeness of these farmers. Similarly, encouraging the smallholder pig farmers to become customer oriented would increase their overall innovativeness. Second, the theoretical contribution of this study is the extension of the market orientation concept to smallholder pig production in a developing country. No such study had been conducted before in pig production in a country in sub-Saharan Africa.

Despite the practical and theoretical contributions of this study, it is not free from limitations. One main limitation is the extent of application of this study's findings. We acknowledge that the findings of this study are only valid in similar circumstances of the smallholder pig production. This is because smallholder pig production practices are diverse and unique and are faced with similar but divergent challenges that may make some of the findings in this study not valid under such circumstances.

Notes

1. In this study, a farmer is considered to be using purchased feed if their main source of feed pigs is through purchase and otherwise if their main source of pig feeds is from locally available resources from at home. Consequently, those who have purchased as their main source of feeds are either buying preformulated feeds or buy feed ingredients and formulate them from home. Whereas it would have added more light by separating between those who use formulated vs. non-formulated, very few of the farmer use formulated feeds, with, those who formulated feeds also incorporating feed ingredients.
2. The varimax rotation is commonly used since it minimizes the number of items that load on each other, thus making it easy to interpret (Janssens *et al.*, 2008)
3. The exotic breeds in Uganda consist of a mix of old British and modern European breeds (Babigumira *et al.*, 2021, 2022). These include: Large White, Land race, Wessex saddleback, Duroc, Hampshire and Camorough (Babigumira *et al.*, 2021; Twine and Njehu, 2020; Tatwangire, 2014). In this study, all these breeds were treated as exotic since capturing them individually would have created the complexity of having so many categories in one variable. Nevertheless, this does not any affect the validation of our findings.

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